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Bulletin 45
October
2003

L.U.S.T.LINE

A Report On Federal & State Programs To Control Leaking Underground Storage Tanks

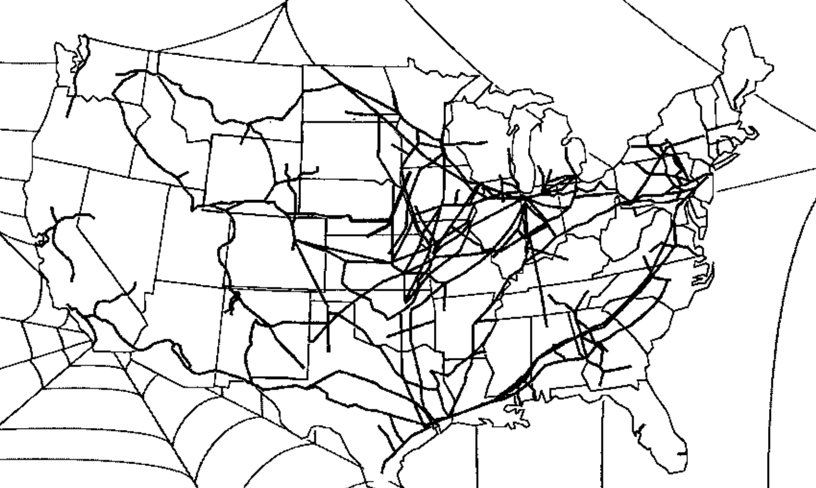
Oh What a Tangled Web!

Gasoline Oxygenates, Petroleum Distribution Networks, and Detections in Groundwater at LUST Sites

by Michael Martinson

Over the past several years, groundwater analyses at leaking underground storage tank (LUST) sites across the U.S. have detected various ether oxygenates, including MtBE, from releases of gasoline, fuel oil, and other petroleum products. Interestingly, many of these oxygenate detections occur in state locations where the use of ether-oxygenated or reformulated gasoline (RFG) has never been mandated for clean air requirements. South Carolina, for example, has never required the use of oxygenated gasoline, yet MtBE has been found at 72 percent of all LUST release sites and at 85 percent of all corrective action releases (Shrader 2002).

So what's going on here? Certainly the use of oxygenates for all purposes, including octane boost, RFG, or oxyfuel, all contribute to the "cross-contamination" issue. However, the U.S. pipeline distribution system and its operations also offer plausible explanations for the widespread detections and occurrences of gasoline oxygenates in LUST site groundwater. Let's take a look at this tangled and perplexing system.



U.S. REFINED PRODUCT PIPELINE NETWORK

Petroleum Shipments in the U.S.

Data for 2001 indicate that approximately 19.5 million barrels (819 million gallons) per day of petroleum products are consumed in the U.S. (Trench, 2001). Approximately two-thirds of the petroleum shipped in the U.S. travels via oil pipelines. The balance of the distribution methods includes barge trucking, railroad, and waterborne shipments.

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Inside

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the balance of the oil production takes place in California. Almost all of the refining capacity is met from California state refineries that produce unique product specifications.

The manufacturers of MtBE and other ether oxygenates are numerous. (See Figure 1.) In 1999, MtBE oxygenate supplies were produced from at least 28 U.S. suppliers (ChemExpo Chemical Profile, 2000). In 1998, approximately 25 percent of the MtBE used in the U.S. was from imports (Oak Ridge National Laboratories, 2000).

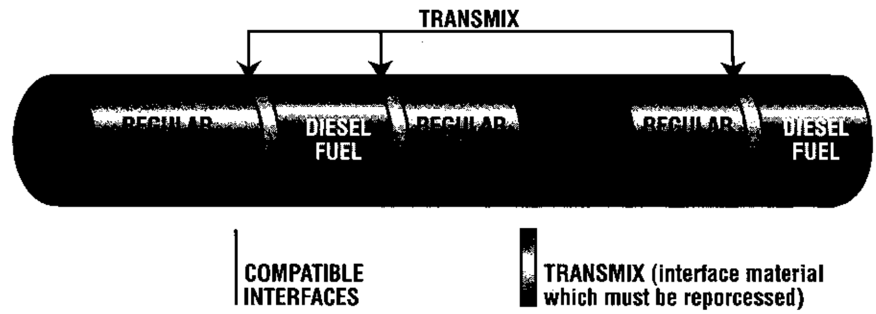
The produced oxygenated gasoline products vary in their oxygenates content, depending on clean air mandates, use as octane boosters in the gasoline, and other factors associated with supply and demand. MtBE is combined with refined gasoline per shipping specifications for shipment to ultimate distribution points.

As oxygenated gasoline enters the refined products distribution network of pipelines, it enters a system encompassing various geographies, numerous manufacturers, and gasoline products with varying MtBE and other oxygenate contents. These all contribute to a national complex of widespread MtBE distribution, both intended and unintended. In addition, the refined petroleum product passes through many of the more than 2,500 pipeline terminals, starting at the point of production, during the pipeline transmission process to its final distribution point (Penn Well, 2002).

In Maine, a state where oxygenate-containing RFG use is not required, there is considerable variability in MtBE content in gasoline. The Maine Department of Environmental Protection (DEP) monitors and reports annually on levels of MtBE in shipments of gasoline to storage terminals that have a throughput of more than 20,000 gallons of gasoline per day in the state. Terminals in Maine reporting data were owned by Gulf, Irving, Mobil, Motiva, and Webber. Although the goal for Maine has been to eliminate MtBE from gasoline this has, so far, been next to impossible. The average level of MtBE in gasoline for 2002 was 2.44 percent (by volume) in gasoline, ranging from 0 to 14.53 percent MtBE (Maine DEP, 2003). Shipments with 11 percent or higher are most likely loads of RFG that have ended up in Maine, one way or another, when they shouldn't have.

Figure 2

TYPICAL SEQUENCE OF PETROLEUM PRODUCTS FLOW THROUGH A PIPELINE



Residual Refined Product Mixing During Distribution

Another contribution to the nationwide distribution of MtBE and other oxygenates, even to locations that do not use or need them, is the mixing of residual petroleum products within the pipelines, terminal storage tanks, bulk shipments in barges, and final distribution to retail sites via tanker trucks. Even fuel oil supplies have been found to have significant MtBE and other oxygenate concentrations due to residual volumes of oxygenated gasoline mixing with fuel oil shipments in pipelines, barges, and tanker trucks.

In pipeline transmission operations, it is common practice to ship different petroleum products or grades of the same product in sequence through a pipeline, with each product or "batch" distinct from the preceding or following (Allegro, 2001). Transmix interface materials are used to separate refined petroleum products (e.g., fuel oil or diesel fuels separated with a transmix from gasoline shipments). (See Figure 2.) However, the various grades of gasoline products are not typically separated during pipeline transmission. The mixing of gasoline grades and their respective varying oxygenate concentrations can result in the inadvertent distribution of residual

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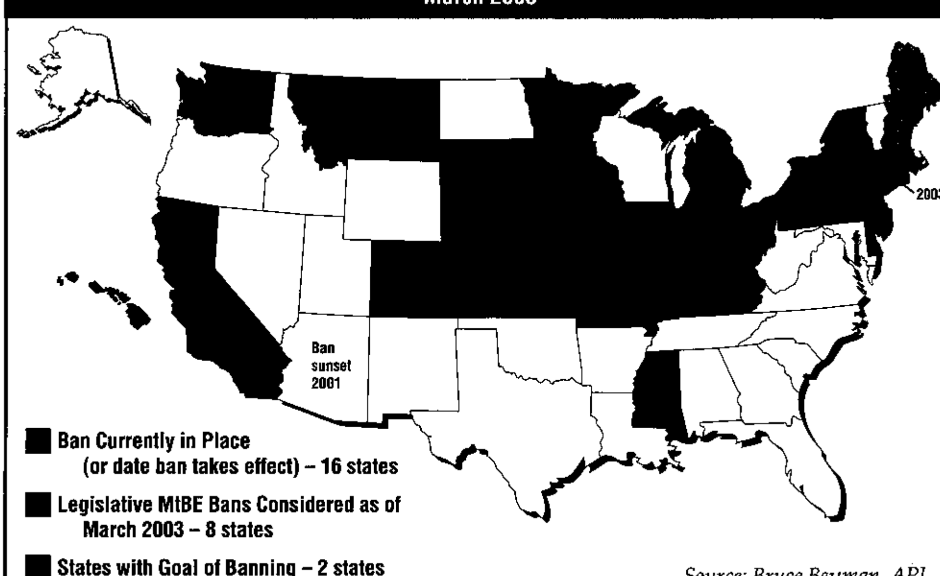
Figure 3

STATE MtBE BANS
March 2003



Source: Bruce Bauman, API.

do not investigate oxygenate plumes differently. It is clear, however, that many states are aware of the diving plume issue but that many deal with this situation on a case-by-case, risk-related basis.

Only 11 states require three-dimensional characterization of plumes, and less than half of the states are taking extra steps to make sure oxygenates are not migrating beyond standard monitoring parameters. The typical types of steps cited include:

- Multilevel sampling (nested wells, shorter-screened wells)
- Deeper wells
- Monitoring of drinking water wells downgradient or in the area of an MtBE release

In instances where there is no state standard for an oxygenate compound, factors states use to determine when to test for them are primarily proximity to drinking water receptor and general vulnerability analysis.

Thirty-five states allow for dynamic work plans (i.e., field-determined based on site conditions) with respect to well placement and screen positions.

Based on the responses to this survey, most states do not intend to reopen closed sites to look for MtBE or TBA unless they have reason to suspect a problem. Yet 32 states said MtBE plumes are often or sometimes longer than typical BTEX plumes. The survey indicates that MtBE in groundwater is detected in gasoline releases (averaged among the states) 60 percent of the time.

Sixteen states responded that oxygenate levels exceed groundwater action levels somewhere between 0 and 20 percent of the time; five said 20 to 40 percent of the time, six said 40 to 60 percent, six said 60 to 80, and nine said 80 to 100.

Reported highest concentrations of MtBE in the hot spot/core of a plume ranged from 200 to 9,131,994 ppb; receptor concentrations ranged from 6 to 28,000 ppb. (These concentrations are considerably higher than those reported in 2000.) Concentrations in TBA hot spots ranged from 215 to 250,000 ppb; receptor concentrations ranged from 12 to 1,000 ppb. Concentrations in TAME hot spots ranged from 41 to 170,000 ppb; receptor concentrations ranged from <5 to 1,000 ppb.

MtBE Plume Lengths

Eighteen states said they track MtBE plume lengths from gasoline releases; 15 said they sometimes do. Sixteen states reported that these plumes are often longer than typical BTEX plumes; 16 said they are sometimes longer, three said rarely, and 12 did not know. Tables 1 and 2 summarize the average and maximum lengths of MtBE plumes observed in individual states. The MtBE plume in East Patchogue (Long Island), New York was more than 9,000-feet long. Table 3 summarizes the maximum length of any MtBE plume observed in bedrock. Only 17 states were able to provide estimates for this question.

Table 1
Average MtBE plume lengths

PLUME LENGTH (feet)	# OF STATES
10 - 50	0
51 – 100	3
101 – 250	12
251 – 500	10
>500	2
Don't know	8

Table 2 Maximum length any MtBE plume observed in a state

PLUME LENGTH (feet)	# OF STATES
50 – 250	1
250 – 500	3
500 – 1000	2
1000 – 5000	26
>9,000	1
Don't know	16

Table 3 Maximum length any MtBE plume observed in bedrock in a state

PLUME LENGTH (feet)	# OF STATES
50 – 250	0
250 – 500	3
500 – 1000	3
1000 – 5000	11
Don't know	30

MtBE Impacts in Drinking Water

Twenty-four states reported that their drinking water program requires routine analysis for MtBE in drinking water. (This number was the same in 2000.) Seven states did not know the answer to this question. The failure of 26 states to routinely analyze for MtBE reflects back to the lack of a federal MCL.

Drinking water programs in Minnesota, New Hampshire, New Mexico, and Rhode Island began analyzing for MtBE in the mid to late 1980s. Most of the other states began analysis in the late 1990s to early 2000s.

Sixteen states reported that their LUST program routinely reviews MtBE data from the drinking water program. Based on these responses, it appears that there is a disconnect between more than half of the state LUST programs and drinking water programs.

Table 4 shows state estimates of numbers of public and private drinking water wells that have been contaminated by MtBE at any level.

■ continued on page 6

Table 4 State estimates of numbers of public and private drinking water wells that have been contaminated by MtBE at any level.

# OF WELLS	# OF STATES (PRIVATE)	# OF STATES (PUBLIC)
1 – 10	9	12
11 – 50	3	7
51 – 100	6	2
101 – 500	9	5
> 500 (provide an estimate)	NH: 30,000 – 40,000 NY: 866	

From the Editor

To Drinking Water, with Love

While we had several very positive responses to Patricia Ellis' article, "A Hot Dog by Any Other Name Could be Your Drinking Water," in the last issue of *LUSTLine* (#44), we did receive a somewhat outraged response from a reader on the drinking water side of the equation, who found three statements in the article to be "false or misleading":

- "But most water suppliers analyze for a couple dozen contaminants at most." (page 2, second column, second line)
- "Generally an accounting gimmick, such as 30-day average concentration, is employed so that it can be claimed that although detected above the limit, the concentration did not exceed "permissible" levels and the water is safe to drink." (page 2, second column, second paragraph)
- "...we have no idea what contaminants are really in the water we drink. ..." (page 4, third column, third paragraph)

Taken out of context, these statements appear quite brazen. As editor, I could have tempered these statements to avoid controversy. But as editor of a publication produced by the New England Interstate Water Pollution Control Commission and as an environmental professional, I, too, make water (the "blue gold" of our time) my primary concern.

This article points out, in one LUST regulator's voice, concerns shared by many regulators. This is why I ran the article on the cover; I felt the message was important. After all, as Ms. Ellis mentions in the article: "Although not limited to organic compounds, the Chemical Abstract Service (CAS) assigns unique registration numbers (known as CAS or CASRN) to new chemicals at a rate of about 4,000 per day!!!"

This article is not meant to be an attack on state and federal drinking water programs and water suppliers. Though not stated explicitly in the introduction, the article refers throughout to organic contaminants and more specifically to the several hundred that occur in petroleum products (especially gasoline). For any federal or state drinking water program to think it could stay on top of this chemical assault would be like tilting at windmills. The real solution, reducing our use of these chemicals and preventing them from getting into our environment, is equally quixotic.

Nevertheless, I will attempt to shed some light on the reader's concerns and Ms. Ellis' responses.

A Couple Dozen Contaminants?

In response to the reader's concerns, Ms. Ellis states that "under Safe Drinking Water Act (SDWA) requirements, analysis is required for less than 100 contaminants. About one-fifth of these are organics, and of these, only four (BTEX) are found in petroleum products. Standard drinking water analysis methods (e.g., Method 502.2) have only a "couple dozen" organic contaminants on their respective lists of target analytes, and of those that are on the list, typically the only petroleum constituents are BTEX."

As reported in NEIWPCC's 2003 oxygenate survey of the 50 states, only 24 states indicated that their drinking water program requires routine analysis for MtBE in drinking water. There is no federal standard for MtBE.

Accounting Gimmick?

With regard to the accounting gimmick issue, the reader writes that "EPA establishes standards and the means for which compliance is determined. For several contaminants, averaging is used to determine compliance. The guidelines for doing so are set forth in state statutory rule requirements and are legally binding. They are not 'accounting gimmicks' by which water suppliers can manipulate analytical results to their advantage. If an operator does so, he/she will be held legally liable for their actions."

In her response, Ms. Ellis says that if a contaminant is detected at any concentration, it is in fact present in the drinking water. "Whether or not the concentration exceeds some regulatory level (e.g., an MCL) is relevant from a legal perspective," Ellis says, "and although a water purveyor may not be legally required to disclose the presence of the contaminant to the consumers, this does not necessarily mean that the water is in fact safe to drink."

The author explains that all of these regulatory limits were established with the assumption that no other contaminants were also present. As discussed in the article, there is essentially no information on the effects of dilute mixtures (as would be found in drinking water). At best the presumption is that effects are additive, if they're even considered at all. This is not necessarily a good assumption, and it's certainly not erring on the side of caution.

We Have NO idea?

The drinking water reader writes: "The word 'no' is an extreme exaggeration especially in reference to the writer's first sentence on page two—'The drinking water supply systems in the United States are unquestionably the best in the world.'" The reader goes on to say that EPA undergoes an extensive process to set standards and ensure the safety of our drinking water. "The 1996 amendments to the SDWA require EPA to go through several steps to determine, first, whether setting a standard is appropriate for a particular contaminant, and if so, what the standard should be," says the reader.

"Peer-reviewed science and data support an intensive technological evaluation, which includes many fac-

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LUST Innovations, TRIAD, and Computer Imaging Move LUST Site Investigation into the 21st Century

by June Taylor

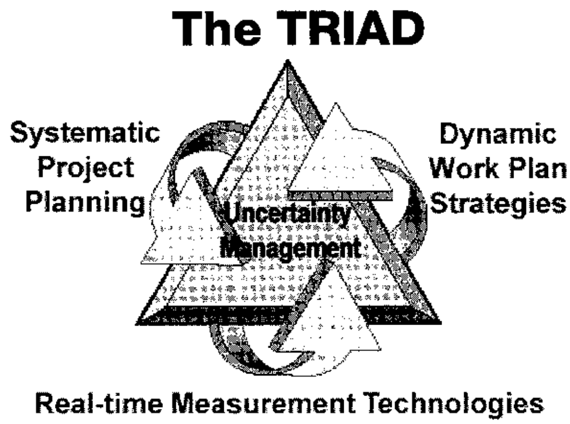
Good site investigation is the most critical factor in successful remediation. Having enough data from a large portion of the site reduces uncertainty and allows targeting of cleanup activities. The ability to adapt plans as new information becomes available further improves cleanups and saves money. These ideas are the driving force behind U.S. EPA's push for the TRIAD approach to site characterization.

The TRIAD approach to managing the inherent uncertainties of investigating contaminated sites incorporates three key elements:

- Systematic planning (knowing what you are looking for and what you will do when you find it)
- Dynamic work plan strategies (being able to change course/let new data guide actions)
- The use of real-time measurements to accelerate and improve the cleanup process (using in-field technologies to get more data more rapidly)

Most of the real-time/in-the-field measurement techniques were first given widespread application at LUST sites. With the vast number of sites, it was simply too expensive to do things the old fashioned way—to "poke and hope," drilling a few monitoring wells and hoping to hit the "hot spot" of contamination.

"EPA's Office of Underground Storage Tanks (OUST) was very open to trying new technologies and giving people flexibility—that helped innovation," says Deana Crumbling, an environmental scientist with EPA's Technology Innovation Office (TIO) which is promoting TRIAD. Also, the liability problems of getting it wrong—missing a plume that would continue to pollute drinking water—pushed industry and regulators to find better methods.



The Bigger Picture Advantage

Unlike numerous hazardous waste sites that may have a wide range of contaminants, most LUST sites benefit from having only a limited number of very detectible volatile organic compounds (VOCs).

"With LUST sites, you know what the constituents are you're looking for; you're looking for VOCs, for benzene, for MtBE," notes Tom Schruben, an environmental engineer with long experience in LUST issues.

Since the costs of using direct sensing devices are so much lower, you can get that vertical data at multiple points across a site, yielding a much better "picture" of subsurface contaminants. By contrast, drilling individual monitoring wells is expensive; so fewer spots are tested, leaving greater uncertainty.

A range of field-based and handheld devices allows for quick detection of such compounds throughout the site without the need to send samples to the lab. Examples of these direct/in situ sensing tools are membrane interface probes (MIPs) and laser induced fluorescence (LIF). These techniques are much faster than pulling up water samples from a well and shipping them to a laboratory for analysis. Instead of drilling monitoring wells that pull up samples every few feet, these devices can take measurements every inch down to 100 feet, giving a continuous vertical profile of contamination.

"This is important because we're finding that the subsurface is very heterogeneous," notes TIO's Crumbling, "You can have a sand layer, for example, and within 8 inches what you'll find will be very different. It's easy to miss the contamination."

Since the costs of using direct sensing devices are so much lower, you can get that vertical data at multiple points across a site, yielding a much better "picture" of subsurface contaminants. By contrast, drilling individual monitoring wells is expensive—so fewer spots are tested, leaving greater uncertainty.

"The differences in the amount of data you can get for similar costs is amazing," says Schruben, adding, "This really makes a big difference in characterizing a site; you're likely to find not just hot spots, but also the source of the contamination and the extent of contamination across a whole site, as well as how the contamination relates to soil strata and pathways."

The TRIAD approach encourages site managers to adjust their investigation as data reveal contaminant hotspots and pathways. This is now much easier to do quickly, given in-field techniques that provide instant or real-time readings of contamination levels. (See a list of sources for information describing MIPs, LIF,

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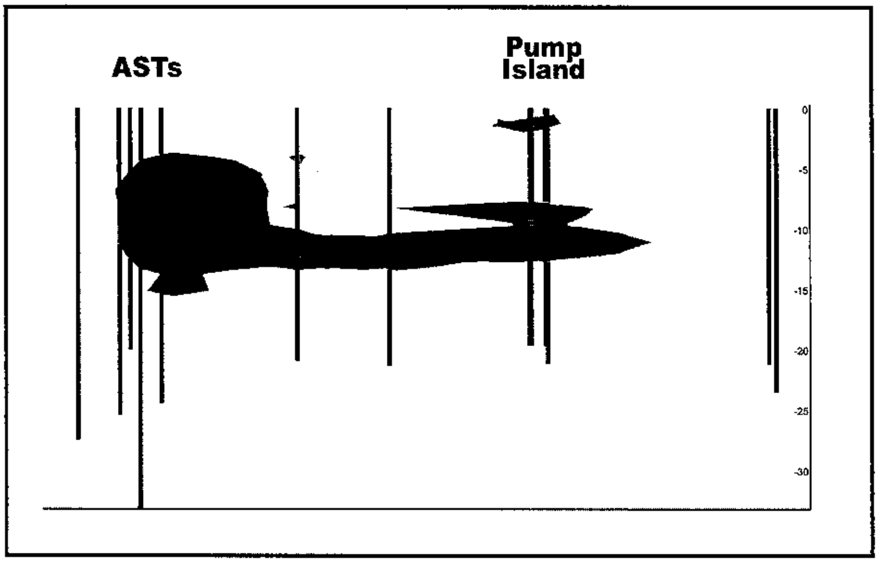
Figure 1
Leaks and Spills Clearly Defined and Pictured: Diesel and Gasoline from Aboveground Storage Tanks (ASTs)



Computer graphic by Columbia Technologies/SmartData Solutions

In this depiction of LNAPL at a South Dakota bulk fueling and dispensing service station, the lighter gray areas are the more intense hot spots. (In full color these would be yellow, orange and red.) A dozen vertical probes using laser-induced fluorescence (LIF) accurately measured the source areas and the depth and extent of the LNAPL plume. Previously, the state had sunk 35 monitoring wells covering a two-block long area, but not gotten a clear picture of the vertical and horizontal distribution of the LNAPL at the site. In fact, the state has concerns that improperly screened wells drilled through a perched watertable may be conduits for LNAPL to move deeper into the sandstone formation beneath the site. ■

Alaska Implementing TRIAD Approach at LUST Sites in Fairbanks

On October 9, representatives of the Alaska Department of Environmental Conservation (ADEC), the Argonne National Laboratory (ANL), EPA's Technology Innovation Program (TIP), Region 10, and the EPA Office of Underground Storage Tanks conducted a kick-off conference call to discuss the use of the TIP "TRIAD Approach" on contaminated UST sites in Fairbanks. (See related article on page 9.)

ADEC is currently implementing an areawide approach to address clusters of LUSTs and other contaminated sites (consistent with OSWER's Land Revitalization and One Cleanup initiatives) in an area of Fairbanks designated as the Fairbanks Areawide Industrial Reclamation (FAIR) project. Given Alaska's limited resources to continue with this project and the pending sunset of its state cleanup fund, TIP will work with ANL and other public/private partners to assist the state in developing the best process for collecting information to meet project and program goals in a timely and cost-effective manner. As the FAIR project moves forward, Alaska intends to apply this streamlined areawide management and risk-based approach to other clusters of sites in the state. ■

EPA's Treatment Profile Web Site Provides Real-World Data about the Treatment of MtBE and Other Fuel Oxygenates

by John Quander and Michael Berman

Data from the U.S. EPA's Office of Underground Storage Tanks indicate that out of 436,500 confirmed releases of gasoline into the environment, 139,500 still require cleanup (EPA, 2003). Many of these sites are contaminated with fuel hydrocarbons, most often benzene, ethylbenzene, toluene, and xylene (BTEX) compounds, as well as the common fuel oxygenate methyl *tertiary*-butyl ether (MtBE) and other fuel oxygenates, such as ethyl *tertiary*-butyl ether (EtBE), *tertiary*-amyl methyl ether (TAME), diisopropyl ether (DIPE), *tertiary*-butyl alcohol (TBA), ethanol, and methanol.

There are many challenges associated with the characterization and remediation of sites contaminated with MtBE and other oxygenates. For example, fuel oxygenates are generally more soluble, less likely to partition to organic matter in soil, and slower to biodegrade than other contaminants in fuel, such as BTEX constituents. These properties lead to larger and more widespread groundwater plumes and challenges with employing certain treatment technologies. These factors also have an impact on our ability to characterize the nature and extent of contamination involving fuel oxygenates.

Technologies available to cleanup MtBE and other oxygenates in soil, groundwater, and drinking water include: air sparging, bioremediation (in situ and ex situ), in situ chemical oxidation, groundwater pump and treat, multiphase extraction (MPE), soil vapor extraction (SVE), phytoremediation, and ther-

■ continued on page 12

it is included in the treatment profiles. As shown on Table 2, data were available for several contaminants including MtBE, TBA, TAME, DIPE, ethanol, and BTEX. All projects reported MtBE as a contaminant with many (71%) also reporting BTEX. TBA (11%), TAME (2%), ethanol (1%), and DIPE (<1%) were reported as being present for only a small percentage of the sites. For the 340 projects, 275 (81%) provided MtBE concentrations (either initial or final concentrations, or both) and 84 (25%) provided an MtBE cleanup goal. Reported MtBE treatment goals ranged from 5 μg/L to more than 10 mg/L, with a median treatment goal of 110 μg/L.

Table 2
Contaminant Distribution for 340 Projects

CONTAMINANT TYPE	PROJECTS REPORTING CONTAMINANT	PROJECTS PROVIDING CONCENTRATION DATA	PROJECTS PROVIDING CLEANUP GOALS
OXYGENATES			
MtBE	340 (100%)	275 (81%)	84 (25%)
TBA	36 (11%)	29 (8%)	4 (1%)
TAME	6 (2%)	0	0
Ethanol	3 (1%)	0	0
DIPE	1 (<1%)	0	0
OTHER CONTAMINANTS			
BTEX	243 (71%)	190 (56%)	13 (4%)

■ Treatment Technology Performance

Of the 340 projects, 104 (30%) were complete as of the July 2003 update. Technology performance information is included for these projects in the treatment profiles, primarily in terms of changes in concentration of MtBE in the groundwater. Soil data are seldom reported and not included in the database. MtBE concentrations before and/or after treatment are available for 275 projects in the database. In general, the highest concentration reported prior to treatment and the highest concentration after treatment was completed (shown as "final concentration") is provided.

■ Treatment Technology Cost

Of the 340 projects, 162 provide some form of cost data. Most of these projects (151 of the 162 projects with cost data) employed bioremediation, pump and treat, SVE, or air sparging alone, or one of three combinations of technologies: air sparging and SVE; air sparging, SVE, and pump and treat; or SVE and pump and treat. Both total costs and unit costs based on area treated for the projects employing pump and treat either alone or in combination with other technologies were upwards of twice that of projects employing only *in situ* technologies.

It should be noted that most of the costs included in this analysis are for ongoing projects (129 of 162 projects). Therefore, the total costs for many of the projects may eventually be greater than what is currently reported in the treatment profiles. In general, there is limited cost data available. However, an analysis of this data suggests that systems designed to treat other fuel oxygenates in addition to MtBE may be more costly than those that treat only MtBE.

Other Resources for MtBE Treatment

Additional EPA resources about MtBE and other oxygenates are listed below.

- **EPA's MtBE Web Page** – A list of Frequently Asked Questions provides basic background information on MtBE, as well as links to other Web sites. Available at *http://www.epa.gov/mtbe*

- **EPA's Office of Underground Storage Tanks MtBE Web Page** – General information about MtBE and USTs. Available at *http://www.epa.gov/swerust1/ mtbe/*

- **Clu-In** – Information about innovative treatment and site characterization technologies. Serves as a forum for waste remediation stakeholders. Available on line at *http://www.cluin.org*

- **TechDirect** – Hosted by EPA's Office of Superfund Remediation and Technology Innovation, a monthly e-mail that highlights new publications and events of interest to site remediation and site assessment professionals. Sign up online at *http://www.cluin.org/newsletters/*

- **Technology News and Trends** – A newsletter about soil, sediment, and groundwater characterization and remediation technologies. Available on line at *http://www.cluin.org/products/newsltrs/tnandt/m* ■

John E. Quander is a scientist with EPA's Office of Superfund Remediation and Technology Innovation and has over 20 years experience in field sampling and investigations, site remediation and training. He is currently the Project Officer responsible for the development of the MtBE Treatment Technologies Database. He can be reached at quander.john@epa.gov

Michael H. Berman, P.E., is an engineer with Tetra Tech EM Inc. with 10 years experience in site remediation and technology transfer projects. For the past five years, he has supported EPA's Office of Superfund Remediation and Technology Innovation in making information about the cost and performance of emerging treatment technologies more readily available. He can be reached at bermanm@ttemi.com

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Table 1

Borehole concentrations in ppb for various combinations of screen elevation and length. Data from East Patchogue, New York, calculated using the Average Borehole Calculator.

SCREEN LENGTH	TOP OF SCREEN AT 20 FT.	TOP OF SCREEN AT 30 FT.	TOP OF SCREEN AT 40 FT.	TOP OF SCREEN AT 50 FT.	TOP OF SCREEN AT 60 FT.	TOP OF SCREEN AT 70 FT.	TOP OF SCREEN AT 80 FT.	TOP OF SCREEN AT 90 FT.
5 feet	0	279.7	1054.0	5677.0	877.1	1155.0	560.7	79.99
10 feet	0	209.8	1805.0	4849.0	1054.0	994.7	475.5	61.83
20 feet	119.5	760.7	3524.0	3028.0	1130.0	743.5	316.3	36.48

release occurs. Certain models require you to choose whether a release was instantaneous or had occurred over a length of time. (See the section below on Definition of "Source.") This can be especially important in the case of MtBE, as the lack of sorption to soils will allow a one-time release of MtBE to move more as a slug through groundwater than the BTEX constituents, sometimes resulting in a detached plume, whereas a one-time release of BTEX compounds results in a plume that continues to be connected to the source area due to sorption and retardation. (See the sections below on Darcy Velocity and Sorption and Retardation.)

Definition of "Source"

The definition of "source" varies from model to model and person to person. One report that I reviewed, using Bioplume II, showed that all contaminants would be reduced to below MCLs within six months. I thought this slightly odd, since the site had already been around for about 10 years, and, while showing decreasing levels in a few of the wells, it looked like it might take another 10 or 20 years to achieve MCLs at the rate at which it was proceeding.

The consultant was obviously proud of his modeling effort, but I had my doubts. As a matter of fact, over the next few quarters, concentrations increased in most wells as water levels fluctuated. We went back and reviewed some of the model inputs and assumptions.

The consultant said that the model assumed that the source had been removed. I asked him what the "source" was for the site. He said that the old tanks had been removed, and the new tanks were located in a different area onsite and weren't leaking. It didn't seem to occur to him that the area of the old tank field, where some of the wells still periodically had free product, could be considered to be a continuing source, so he really had a plume that should more correctly have been modeled as a continuing source, rather than as an instantaneous release.

Many of the models that I have reviewed have had poorly characterized plumes. Areas of maximum concentration have not been located, and the data from the "hottest" area observed might not be the "hottest" area that is out there for input into the model.

Sorption and Retardation

The transport of organic chemicals in groundwater is typically slower (i.e., "retarded") relative to the velocity of the groundwater. Retardation (R), which is both chemical specific and organic-content specific, is due to sorption and is defined as:

$$R = 1 + (\rho_b / n) \cdot K_d$$

where:

ρ_b is the bulk density of the aquifer material (soil)

n is the porosity

K_d is the chemical-specific soil-adsorption coefficient (or distribution coefficient), which is defined as:

$$K_d = foc\ K_{oc}$$

where:

F_{oc} is fraction organic carbon

K_{oc} is the organic carbon partition coefficient (chemical specific)

The higher the K_d, the greater the retardation. The retardation factor for benzene is different than that of MtBE because the organic carbon partition coefficients are different. Retardation also varies with soil types, based on the amount of organic carbon present. If you are going to model fate and transport of chemicals in the environment, you need to have a model that will account for these differences. You wouldn't expect Benzo(a)pyrene to behave the same as BTEX, so why should you expect MtBE to behave the same as BTEX? Fraction organic carbon is sometimes measured at specific sites, but many modelers are content to use default values. Particularly when trying to model MtBE, you need to use a model that accounts for the extremely low retardation.

Dilution and Dispersion

Dispersion coefficients (i.e., longitudinal, transverse, and vertical) are seldom measured directly. The role of dilution and dispersion at a particular site are usually extrapolated from available literature, or determined by calibrating a fate and transport model to field data by adjusting the modeled value for dispersion to best fit the existing monitoring data.

Most transport models assume a uniform flow direction and velocity. As a result, spreading of the plume due to variations in flow direction and velocity are attributed to dispersion and not to the uncertainty in monitoring data describing the direction of groundwater flow.

If there is little variation in flow direction, modeled MtBE plumes usually appear long and skinny. If flow direction is variable, apparent dispersion may be deceiving. What will appear to be lateral dispersion may actually be longitudinal dispersion occurring in different directions. Dispersivity is almost never measured on a site-specific basis, despite its importance in determining model outcomes.

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best-fit decay coefficient for each contaminant. For still-expanding plumes, this steady-state calibration method may overestimate actual decay-rate coefficients and contribute to an underestimation of predicted concentration levels.

Calibration and Sensitivity Analysis

Model calibration is extremely important. However, in calibrating the model there may be ten different inputs that can be varied to get the results to look like the real-site data, therefore the solution is nonunique! How do you know that you are tweaking the right ones to get the model to look like the real-life data? (Or worse, what if the inputs are being tweaked to give a favorable outcome and not necessarily a reasonably accurate one?)

Part of the solution is to conduct a sensitivity analysis. When a given parameter is changed by a specific amount, how much difference is made to the final answer? A model will be more sensitive to certain parameters. In developing Delaware's RBCA program (DERBCAP—Delaware's Risk-Based Corrective Program), a sensitivity analysis showed that the modeling was most sensitive to the inputs for fraction organic carbon, depth to groundwater, source area width, and groundwater velocity. We recommended that consultants stick with the default parameters for the other inputs, because the above-listed inputs were the ones that made the largest difference in the calculated cleanup levels.

Lab-Determined Values v. Field-Determined Values

Biodegradation rates approximately double with every 10°F change in temperature. Why should you use a value from an experiment conducted in the lab at 70°F, when the temperature in the aquifer may be closer to 50°F?

Not enough is known yet about conditions amenable for biodegradation of MtBE in aquifers. Is the aquifer aerobic or anaerobic? Are there sufficient electron acceptors? Are there sufficient microorganisms of the correct kind? The conservative approach would be to turn off biodegradation in your model. Occasionally, I see a consultant use instantaneous decay, but more usually, first-order decay is chosen as the modeling option.

Table 2 **First-order decay rate constant for degradation (per year).**

	Benzene (Suarez and Rifai, 1999)	Benzene (Aronson and Howard, 1997)	MtBE (Wilson)
Number of reported rates	20	16	10
Mean	3.7	3.9	2.3
Median	NA	1.5	0.44/0.56

Source: Wilson, 2003.

The degradation of MtBE under aerobic or denitrifying conditions has been documented at a wide variety of locations. In general, the rates in laboratory experiments, or pilot-scale demonstrations where oxygen is not limiting, are rapid. The median rate is five per year, corresponding to a half-life of two months. Rates that have been documented in the field are much slower, on the order of 0.4 per year or a half-life of two years. It is likely that the field-scale rates reflect the rate of reaeration of the plume, as well as the rate of degradation when oxygen is available.

A good report of a modeling effort will provide a sufficient amount of text to explain what has been done and why, as well as presenting the results of the modeling effort.

"It is extremely important to realize that laboratory-derived rates of biodegradation are almost never comparable to rates observed in the field," says EPA Microbiologist John Wilson. Almost without exception, laboratory rates are much higher, and estimations (or simulations) of the time required to reach remediation goals should never be based on laboratory-derived rates (Wilson, 2003).

There is one well-documented study of natural attenuation under iron-reducing conditions (Landmeyer et al., 1998). To date, no one has shown MtBE biodegradation in aquifer sediments under sulfate-reducing conditions, and data of biodegradation of MtBE under methanogenic conditions are mixed (Wilson, 2003). The geochemistry of a site must be well characterized before you should even hazard a guess as to the half-life of MtBE at a site, because there may be little to no natural biodegradation occurring.

It is generally considered that the rate of natural bioattenuation of MtBE is much slower than the rate of benzene bioattenuation. Table 2 compares rates of natural bioattenuation of benzene in the field as reviewed by Suarez and Rifai (1999), or extracted from the review of Aronson and Howard (1997), to the rates of natural attenuation of MtBE (Wilson, 2003, Tables 3-3 and 3-4). There is little practical difference in the mean rate of natural attenuation of benzene and MtBE. However, the median rate of MtBE degradation is one-third that of benzene.

In BIOSCREEN, if individual constituents are being modeled with the instantaneous reaction assumption, note that other constituents present in the plume must reduce the total biodegradation capacity to account for electron acceptor utilization. For example, in order to model benzene as an individual constituent using the instantaneous reaction model in a BTEX plume containing equal source concentrations of benzene, toluene, ethylbenzene, and xylene, the amount of oxygen, nitrate, sulfate, iron, and methane should be reduced by 75 percent to account for utilization to toluene, ethylbenzene, and xylene (EPA, 1996, 1997).

In a recently submitted report using BIOSCREEN, a consultant modeled each of the constituents separately (i.e., benzene, toluene, ethylbenzene, xylenes, and MtBE), trying to account for the differing physical and chemical characteristics of the contaminants. However, you can't run the model separately for each constituent using the electron-acceptor approach because more than one constituent uses the electron accep-

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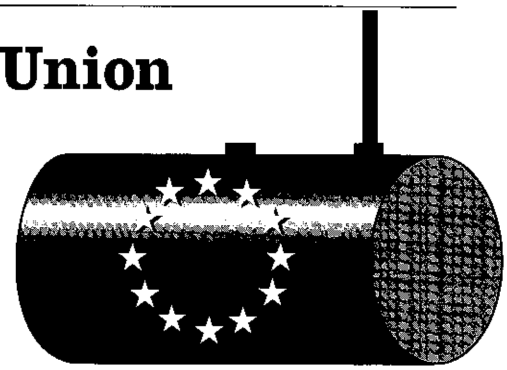
Leak Detection in the European Union

by Jamie Thompson



When a station owner or operator installs a leak detection system, he or she immediately feels much more comfortable with the facility. The same can be said for the regulator, who is concerned with whether the leak detection system has been installed and who checks to see if it is operating properly. Both could be considered to be doing all that is necessary to comply with regulations, as well as doing their bit with regard to environmental responsibility...or are they?

As I see it, one of the biggest problems in the petroleum marketing industry is our understanding of the words "leak detection." I developed my understanding of leak detection after 40 years in this industry. I used to think that London had one of the best leak detection systems in Europe—the London Underground Railway. If a gas station leaked, product soon found its way into one of the 600 miles of tunnel. "Dangerous and not very satisfactory," I can hear you say. Following are some of my present day thoughts on leak detection.

The Need for Reexamination

Leak detection for underground storage tanks and pipes developed following many years of problems, in the United States, Europe, and throughout the world. One of the problems of technology development is that the technologies in the forefront at one moment in time can quickly become the accepted practise and standard. It is essential, though, that we challenge those standards and reexamine our methods as time goes on and better systems are developed.

A prime example is the detection of leaks and what is considered acceptable. Take, for example, the American standard requiring that 760 mL/hr (0.2 gal/hr) be detected 95 percent of the time. Applying the commonly used threshold for declaring a leak of 378 mL/hr (0.1 gal/hr), this standard allows some 3,316 liters (876 gallons) of fuel a year to enter the ground before a release is detected. The regulatory standard for inventory reconciliation in the U.S. is even worse. This rule allows monthly losses of up to 1 percent of the sales plus 492 liters (130 gallons) before failing the tank. For a modest throughput station, this could amount to losses of more than 2,000 liters (528 gallons) per month for monthly sales of 200,000 liters (52,840 gallons).

While these amounts may well have been accepted in the past when our technology was not as sophisticated and we used single-walled storage systems, a conscientious operator or regulator would not be happy to have this amount of product enter the environment today. Yet these are the standards that many of us still use.

The European Union (EU) has been drafting common standards for many years, and one area of those standards that has been worked upon and published this year is BS EN 13160-1 to 7 *Leak Detection Systems*. These standards cover the various methods of leak detection that can be used on tanks and pipes. They are performance standards and have detailed test methods for evaluating equipment to show that it will work (Though they are sometimes more prescriptive than U.S. standards—See Ken Wilcox Article on page 21.).

Positive Leak Detection

One solution to underground storage system releases that has been widely adopted in Europe is what I prefer to call *leak prevention* or *positive leak detection*. This involves the continuous monitoring of the integrity of the two skins of a double-walled tank or pipe. This system has been used in some European countries for many years, and in Germany for underground tanks since 1968. For comparison, the American standard only requires monitoring the integrity of the inner wall of a double-walled tank or pipe.

The basic principle of positive leak prevention is quite simple: you provide a pressure or a vacuum in the tank and piping interstices, and the two skins are always under test for the whole life of the installation. As soon as one of the walls is breached, an alarm sounds, the tank is emptied of product, and no product enters the environment. It is an attractive alternative for both regulator and operator.

Pressure v. Vacuum v. Tradition

Pressure systems pressurize the interstitial space to 440 millibars (6.38 psi) in such a way that a leak anywhere in the interstitial space will cause a detectable pressure drop. Minor long-term pressure losses in the system are restored (within very tight limits laid down in the standard) by a small pressure pump—a low-capacity pump that is provided as part of the system to maintain pressure despite these small pressure losses, thus avoiding periodic false alarms due to "normal" pressure loss.

If a small leak occurs in the internal wall, the pressure pump will attempt to maintain the pressure in the interstice. A major advantage of the positive-pressure system is that the pressure in the interstice prevents any gasoline from entering the interstitial space. When the pressure drops to around 330 millibars (4.79 psi), an alarm will sound, alerting the operator that there is a problem before any stored product can escape to the environment.

Vacuum systems work in a similar way to the pressure systems, but in reverse. A small vacuum pump is used to maintain the vacuum in the interstice. If the vacuum decreases to below a set point, or if liquid is drawn into the tubing leading to the vacuum pump, an alarm sounds. A disadvantage of the vacuum system is that a leak in the inner wall will allow product to enter the interstitial space. The presence of product in the interstice may complicate the process of repairing the tank, if a repair is

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One American's View of the European Approach to Leak Detection

by Ken Wilcox

As most people in the U.S. leak detection industry are aware, U.S.EPA requires that leak-detection equipment meet specific performance standards before it can be used legally to monitor underground storage tanks containing motor fuels. This performance must be verified, usually by an independent third-party evaluation, using specific testing procedures defined in a series of documents produced by EPA in 1990. More recently, other test protocols have been developed by nongovernmental organizations and approved by the National Work Group on Leak Detection Evaluations (NWGLDE).

A parallel effort to develop standard procedures has been occurring over the past ten years or so in Europe. (See "Leak Detection in the European Union" on page 19.) While these procedures are of interest to U.S. UST technology developers and others with an interest in selling equipment in Europe, they have not yet had much direct impact on U.S. evaluation and testing of leak-detection equipment. This may change, however, because the NWGLDE has officially adopted one of the European leak detection evaluation procedures, making it an acceptable evaluation procedure here in the U.S.

The document adopted is EN 13160-2, "Leak Detection Systems – Part 2: Pressure and Vacuum Systems." (This document is copyrighted and can only be obtained from one of the European standards organizations for a nominal fee. One such organization's Web site is contained in the article on page 19.) The protocol applies to interstitial monitoring systems in both double-walled tanks and pipelines and contains procedures for the evaluation of monitoring methods that rely on maintaining either pressure or vacuum in the interstice.

Although the document covers a number of types of leak-detection systems, I will focus my comments only on pressure/vacuum systems for interstitial monitoring, because this is the only part of the document officially adopted by the NWGLDE.

Contrasting Approaches to Environmental Protection

There are a number of features of the European approach to protecting the environment that differ significantly from that of the EPA. Space precludes a detailed evaluation of all the differences, but here are three that merit comment.

- The emphasis in Europe is on the prevention of loss of product to the environment rather than detecting a leak of a specific size (e.g., 0.1 gallon/hour).
- The evaluation protocols from Europe are somewhat prescriptive in nature. Not only is the testing procedure described, but descriptions of how the leak detection equipment should be designed are also provided.
- The testing is focused on the hardware and its capability to continue to operate under a very wide range of temperature conditions ranging from –25°C (–13°F) to +70°C (168°F). The test procedures do not, for the most part, address all the other variables that might be present in a field installation (e.g., size of tank, length of piping, operating pressures of the piping).

Allowable Leaks

The first difference listed above is very fundamental. The Europeans have divided leak detection into five classes. (See article on page 19.) It is interesting to note that most of the methods used in the U.S. are in categories 3, 4, and 5, which do not report leaks until fuel is already in the ground. Most of these methods would not even be allowed as a primary leak-detection method in some countries in Europe.

This fundamental difference has already had an impact in California. With the adoption of SB 2481 (*www.swrcb.ca.gov/ust/docs/eld/index.html*), the regulatory emphasis has shifted to the European focus on loss prevention rather than leak detection. The requirements described in SB 2481 state that pressure, vacuum, or hydrostatic monitoring be maintained in the interstitial space of double-walled pipe for loss prevention purposes.

These rules apply to all new installations after July 2004. They apply to all newly installed storage systems as of July 1, 2003, but the implementation date has been delayed by one year because there was no approved technology available that met the rules that could be applied to American-style pressurized piping systems.

This change in emphasis is initially painful, particularly for station owners, because a whole new type of leak-detection system must now be developed and installed to comply with the new regulations. Although most thoughtful people would agree that the overall objective of loss prevention is a good one, there are some cautions along the way.

It is important for the regulatory community to recognize that some things simply cannot be done as well and as quickly as they would like until the leak-detection industry has an opportunity to develop equipment to meet the new standards. In addition, we need an opportunity to work out the bugs in the new systems before deadlines kick in. Murphy's Law will likely be in effect, and these new systems should not be expected to work perfectly during their initial use.

Approach to Standards

The second difference is a result of two significantly different ways to approach standards for leak detection/prevention: performance-based standards v. design-based standards.

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Field Notes

from Robert N. Renkes, Executive Vice President, Petroleum Equipment Institute

CHANGES IN THE PETROLEUM MARKETING SCENE MAY PRESENT NEW WORRIES FOR UST REGULATORS

Consider the following announcements released by major oil companies during the last several months:

• ChevronTexaco said it would sell 550 gasoline service stations in the United States and 900 in Asia and Africa as it restructures its downstream refining and marketing business.

• Alimentation Couche-Tard Inc. reached an agreement in October with ConocoPhillips to acquire the Circle K Corp., which operates 1,663 corporate stores in 16 states and has a franchising or licensing relationship with more than 350 additional stores. Approximately 86 percent of those stores sell gasoline. The Circle K sale was expected, as ConocoPhillips told investors last December it would sell 3,200 marketing sites this year.

• Shell is planning to shed stations across a broad section of the country, particularly in markets where margins have produced subpar results. The company is also in the process of turning over 1,750 company-owned stores to "multi-site operators," or MSOs, but will retain responsibility for the fuel operations.

It seems clear that the major oil companies have decided to reduce their capital investments in refining and marketing activities to boost overall returns. They have determined, one by one, that they are better at and can make more money by producing oil, rather than running retail gasoline and convenience store operations. And there are other compelling reasons for the majors to shift their focus away from retail marketing:

• All traditional gasoline marketers, including the major oil companies, have faced stiff competition in the form of heavily subsidized gasoline marketed by hypermarkets. Gasoline marketers have acknowledged that hypermarkets are not going away.

• The oil companies' experience with hypermarkets in Europe, most notably in France and Great Britain, has shown that double-digit gasoline margins are not likely to bounce back. As one major oil company vice president of European retail operations told us privately four years ago: "We have given up trying to make money at retail. It just isn't there."

• Price-competitive and very efficient convenience store operators have expanded rapidly into high-growth markets and now have a dominant position in them.

This is not to say that the major oil companies are abandoning retail operations. They will still own tens of thousands of gasoline stations after they sell off the thousands that are on the block. They will still continue to market gasoline in areas where they have strong brands, well-established supply agreements, and competitive market shares. But the days of an ever-growing retail presence appear to be over.

What will this mean to underground storage tank regulators? Here are several possibilities.

• In the 1980s and 1990s, when the majors were expanding their retail locations, they employed a full staff of construction and service engineers. One major oil company engineer told us that he had 150 engineers and trainees on his retail marketing staff at one time. Now six engineers service the entire country for the company. Oil company personnel are spread thin, and UST compliance issues may fall through the cracks. That's a natural result when you have to do more with less.

• Chances are the new owners of stations sold by the majors will not be as sophisticated from an engineering standpoint. Some purchasers may be first-time owners and unfamiliar with what is happening underground. For example, Acme Petroleum & Fuel Co. sold 33 convenience stores at auction on October 2. One company purchased 10 units and another firm bought nine. Seven buyers purchased one unit each. The 33 stores and 14 dealer accounts went to a total of 14 buyers. The majority of these buyers are not oil companies with experience in managing tank programs. They are more likely to be recent immigrants to the United States and speak English as a second language.

• The "Mom and Pops" (one- or two-station owners) are back. They contributed significantly to the UST problem in the 1970s and 1980s and now account for the ownership of over 70,000 convenience stores in the United States. Outreach to these UST system owners may be expensive and time-consuming.

• Look for more station closures in the future. In general, the retail petroleum marketing industry today is barely making enough money to stay afloat. Unprofitable sites that can't be sold will be closed. Stations involved in bankruptcy proceedings may stay shuttered for quite some time. And if station owners can't generate enough money to stay in business, it's difficult to assume that these same people will have enough money to spend on their tank systems.

The petroleum marketing industry is currently undergoing huge changes. Those changes will require UST programs to change as well if the public is going to be served in the future as well as it has in the past. ■

While the presence or absence of a numeric leak or gain rate contained in the SIR report is the most obvious distinction between quantitative and qualitative SIR methods to the casual observer, the distinction between the methods goes much deeper than this. The statistical techniques used in the evaluation protocol for qualitative and quantitative SIR methods are very different.

The quantitative evaluation is much more rigorous because it compares the leak rate calculated by the SIR method to the 0.0, 0.1, or 0.2 gallon per hour leak rate introduced into the inventory data set by the SIR evaluator. In a qualitative SIR evaluation, there are only two possible answers that the method can produce—pass and fail. As in a true/false test question, the SIR method has a 50 percent chance of getting the correct answer without making any calculations. Because the evaluation is based solely on the pass/fail conclusion, no evaluation is made of the ability of the qualitative SIR method to accurately estimate leak rates.

Performance Standard or Reporting Requirement?

Because of Florida DEP's determination that SELA did not meet the new regulatory requirements, compliance inspectors were authorized to cite SELA customers for failing to conduct leak detection because their SIR reports did not include values for calculated leak rate, threshold, or minimum detectable leak. To remedy this deficiency, SELA started reporting these numbers in subsequent monthly reports. SELA did this without the benefit of a third-party evaluation to show that these numbers were accurate.

When confronted with this, SELA argued that the Florida rule had not changed in 1998, that the new regulatory language consisted merely of a requirement to report additional information and that the performance standard for SIR of detecting a 0.2 gallon per hour leak had not changed. Because the performance standard had not changed, SELA argued, no new certification was required.

Florida DEP pointed out that the requirement to report these numbers was contained in a section of the rule entitled "Performance Standards" and that the new requirements were both reporting requirements and performance standards. The DEP argued that in addition to requiring SIR vendors to include leak rates, thresholds, and minimum detectable leak values on their results forms, they must also have some certification indicating that these values are accurately calculated.

Attempts to settle the matter were not successful, and Florida DEP eventually sent a letter of intent to revoke SELA's approval to sell leak-detection services for regulatory compliance. SELA then filed a petition for an administrative hearing to decide the matter before a judge. The hearing to argue the matter took place this past August. A final decision from the judge is not expected before next spring. Until a decision is rendered and the legal process has run its course, SELA continues to operate in Florida.

Your Bottom Line

So why is any of this important outside of Florida? Because the bottom-line message is that leak-detection equipment vendors and service providers still need to be kept honest by a careful comparison of the regulatory requirements to the equipment certification. Specifically with SIR, a SIR method holding only a qualitative certification does not, in my opinion, meet a regulatory requirement to report leak rates merely by adding a leak rate to the output of the software.

The regulatory requirement to report numeric leak rates is a performance standard, because leak rates should not be numbers pulled out of a hat. There has to be a level of confidence associated with these numbers; a level of confidence provided by putting the SIR software through the quantitative EPA evaluation protocol and applying statistical measures to determine the accuracy of the leak-rate calculation.

If your state UST requirements specify that SIR results include a leak rate, you have effectively specified that only SIR methods holding a valid quantitative SIR evaluation may be used in your state. ■

SIR Terms

When used in this article, SIR terms mean the following:

■ **Performance standard** This refers to the regulatory requirements that a SIR method must meet to be deemed a valid leak-detection method. Such requirements may include (but not be limited to) the ability to reliably detect whether a storage system is leaking above a specified leak rate, the ability to accurately calculate leak rates in a data set, or specifications for how inventory data to be used in a SIR analysis must be gathered.

■ **Threshold** For quantitative leak-detection methods, this means the measured (or calculated) leak rate that defines the boundary between a "pass" and a "fail" test result. To achieve a 95 percent probability of detection, the threshold leak rate is typically about one-half the performance standard.

■ **Minimum detectable leak** For a given inventory data set, this means the smallest leak rate that can be reliably detected in a SIR analysis.

■ **Pass** If the calculated leak rate produced by a SIR analysis is less than the leak threshold, and the minimum detectable leak rate is less than or equal to the certified performance standard (0.2 gallons per hour), the test result is "pass."

■ **Fail** If the calculated leak rate produced by a SIR analysis is greater than the leak threshold, the test result is "fail."

■ **Inconclusive** If the calculated leak rate produced by a SIR analysis is less than the leak threshold, and the minimum detectable leak rate exceeds the certified performance standard (0.2 gallons per hour), the test result is "inconclusive." If for any other reason, the SIR test result is not conclusive (i.e., "pass" or "fail"), the result is "inconclusive."

Flex Pipe Class Action Suits Filed

by Thomas J. Schruben

Flexible pipe litigation seems to be on the upswing. UST owners have filed suits against several flexible-piping installers, manufacturers, and component suppliers. Some of the suits have been brought by individual retail operators, one was brought by a former installer and distributor, and two national class action suits have been filed on behalf of UST owners. The two class action suits, Russell Petroleum v. Environ and May's Distributing v. Total Containment, are similar in many respects:

- They are both asking for National Class Action status
- They were filed in Alabama
- They are each backed by consortiums of plaintiff's attorneys
- They allege similar defects and damages
- They name the installer, the manufacturers, and the suppliers of various components as defendants

Russell Petroleum v. Environ

This suit was filed in August, 2003, in Montgomery County Alabama. The plaintiff, Russell Petroleum Corporation, of Montgomery, Alabama, distributes oil and gasoline products and operates convenience stores and motor-fuel dispensing facilities. Russell Petroleum brought the suit individually and as a class representative for all those motor-fuel dispensing facility owners similarly situated in the United States. In 1998, Russell Petroleum contracted with Ken's Sales and Service Company, Inc. of Ashford, Alabama (Ken's), to install underground thermoplastic flexible pipes and sump systems distributed by Environ Products, Inc. (Environ) and designed and manufactured by one or more of the following defendants:

- Dayco Products, Inc.,
- Mark IV Industries, Ltd.
- Parker Hannifin Corporation
- Atofina Chemicals, Inc.

The suit also names "fictitious defendants" A through FF to allow for the later addition of other parties that are found to have manufactured or supplied components to Environ.

The suit alleges that on or about March 4, 2002, Russell Petroleum discovered that the Environ flexible pipe at its location was defective. Upon inspection and testing, it was discovered that the very properties of the Environ flexible pipe had changed, in that fuel was permitted to permeate outside the barriers of the flexible pipe and that the pipe failed to retain its shape and rigidity, experiencing elongation, swelling, and other defects. Russell Petroleum claims that it suffered damages as a result of the defective Environ flexible pipe. The suit seeks injunctive relief requiring Environ to pay for the removal and replacement of its defective flex pipe. The suit states that the principal common issues for the class are:

- Whether the Environ flexible pipe is defective
- Whether the components of the flexible pipe are defective
- Whether the defendants knew or should have known that the flexible pipe was defective
- Whether the defendants knowingly sold a defective product
- Whether the conduct of the defendants was fraudulent
- Whether the conduct of the defendants constituted negligence, recklessness and/or wantonness in regard to the class
- Whether defendants negligently, recklessly and/or wantonly designed, manufactured, and/or marketed Environ flexible pipe
- Whether defendants failed to adequately inspect or test the flexible pipe
- Whether defendants failed to give warnings or to give adequate warnings regarding the limitations of the Environ flexible pipe
- Whether defendants made an express warranty(ies) concerning Environ flexible pipe
- Whether the defendants breached an express warranty(ies) regarding the flexible pipe
- Whether the defendants breached an implied warranty(ies) regarding the Environ flexible pipe

Because of the wide use of flexible-pipe and sump systems at motor-fuel dispensing facilities over a substantial period of time in the United States, Russell Petroleum believes there are thousands of members of the class.

The lead law firm of the consortium of plaintiff's attorneys is DeHay & Elliston, LLP of Houston, Texas. The lead attorney for DeHay & Elliston on flexible-piping failure cases is Jay Cawley.

May's Distributing v. Total Containment

This suit was originally filed in March 2003, in Bullock County Alabama and was amended in July. The plaintiff, May's Distributing Company, Inc. of Union Springs, Alabama, distributes oil and gasoline products and operates convenience stores and motor-fuel dispensing facilities. May's brought the suit individually and on behalf of all those motor-fuel dispensing facility owners similarly situated in the United States. In 1997, May's Distributing contracted with Oil Equipment Company, Inc. (OEC) to install underground thermoplastic flexible pipes and sump systems distributed by Total Containment, Inc. (TCI) and designed and manufactured by one or more of the following defendants:

- Dayco Products, Inc.
- Mark IV Industries, Ltd.
- Parker Hannifin Corporation
- Ticona Polymers, Inc.
- Shell Chemical, LP,
- Cleveland Tubing, Inc.

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Sacramento County and 10 Water Utilities Sue Over MtBE in California

As if the New Hampshire suit weren't enough, the MtBE pot is being stirred big-time in California. The Sacramento County District Attorney's Office and 10 water utilities are suing the nation's major gasoline producers to pay for the cleanup of MtBE-polluted groundwater. The lawsuit, filed on October 2, 2003, in Sacramento Superior Court, is believed to be the first of its kind to claim damages for threatening drinking water wells.

The claimants allege in the lawsuit that the oil companies knew that MtBE was a risk to drinking water years before they doubled its volume in gasoline to meet clean-air requirements, yet they went ahead and marketed the product as being better for the environment. The suit seeks to obtain from the oil companies "all necessary funds to investigate, monitor, prevent, abate, treat, and contain" MtBE pollution of groundwater in the county and of any wells that may become contaminated in the future. In addition, it seeks to be able to pursue civil penalties for violation of the state's laws for protection of and safe disposal of hazardous waste.

Both this and the New Hampshire legal action come as Congress debates a "safe harbor," provision in the federal energy bill, which would protect the makers, distributors, and users of MtBE from liability for environmental cleanup. (See related article on page 32.)

ARCO/BP to Pay San Diego $4 Million for UST Violations

BP West Coast Products, operator of more than 100 ARCO stations in San Diego County, agreed on September 29 to pay the county and city of San Diego $4 million for violations of California law regarding the monitoring and maintenance of USTs. After four years of inspections, the city and county discovered more than 1,300 violations at ARCO station, many involving sensors installed to detect leaks that "had been tampered with so that they wouldn't go off."

Father and Son Go to Prison for UST Violations in Connecticut

Russell W. Mahler, 77, and his son, Russell Mahler II, 43, pleaded guilty in Connecticut Superior Court to multiple charges, including the discharge of gasoline into water and failure to properly close an underground storage tank. The father, who has gone to prison twice before for illegally dumping toxic waste into landfills in New York and abandoned coal mines in Pennsylvania, pleaded guilty to five counts and received a sentence of six years of incarceration with three years suspended. The son pleaded guilty to four counts and was sentenced to three years of incarceration with two years suspended. The father was also ordered to pay nearly $498,000 in restitution.

According to state prosecutors, the Mahlers failed to update and monitor the tanks as required by state law and in some cases abandoned some gas station/convenience store sites without proper tank closure. Failure to follow the UST regulations at one location resulted in the discharge of 2,500 gallons of gasoline into the groundwater and put a nearby theatre at risk of exploding.

After serving a year in federal prison for dumping waste, including cyanide, into an abandoned coal mine in Pennsylvania that ultimately left a 30-mile slick on the Susquehanna River, Russell Mahler came to Connecticut and opened a number of gas stations with his son. They owned and operated these businesses under a variety of corporate and entity names.

For at least 10 years the Connecticut Department of Environmental Protection had initiated several enforcement actions against both Mahlers. The elder Mahler had the dubious distinction of being the subject for about a page and a half in the book *Poisoning for Profit: The Mafia and Toxic Waste in America* by Alan Block and Frank Scarpitti. ■

EPA HQ UPDATE

States and EPA Implement New UST Program Performance Measures for FY 2004

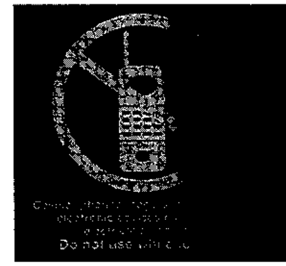
U.S. EPA's Office of Underground Storage Tanks (OUST), in cooperation with the Association of State and Territorial Solid Waste Management Officials, revised its approach for measuring significant aspects of operational compliance. The revised measures will be used to evaluate the UST program's success in promoting the environmentally safe operation of USTs. A memorandum describing the new reporting requirements and the criteria for determining "significant operational compliance" (SOC) was sent to the states and U.S. EPA Regions. The memorandum and related documents, including matrices, can be seen at *www.epa. gov/oust/cmplastc/soc.htm.*

USTfields Pilot Results in Four New Homes in Oakland, California

On October 11, 2003, the East Bay Habitat for Humanity and its partners welcomed four families to their new homes at 2662 Fruitvale Avenue in Oakland. The property had been a contaminated gas station site. A partnership consisting of the East Bay Habitat for Humanity, the State of California, the City of Oakland, the Alameda County Department of Environmental Health, and U.S. EPA worked together to investigate and clean up petroleum contamination to make the property ready for reuse as a site for affordable housing. The remediation work had been funded in part by an USTfields Pilot grant. For further information, see *www.epa.gov/region09*. To find out more about the U.S.EPA/Habitat for Humanity partnership, see *www.epa.gov/brownfields/pdf/habitat.pdf.*

The Exploding Cell Phone at Gas Stations: Fact or Fiction?

by Ben Thomas



THE SIGN AT THE DISPENSER:
To keep you fire-free or simply focused?

You've probably heard the story about the cell phone somewhere that sparked during a vehicle fueling and caused a fire or explosion at a gas station. Allegedly, the cell phone was the source of a spark that, combining with a cloud of gas vapors, accumulated around the dispenser, and rocketed the cell user off his/her feet and into the hospital.

The scenario sounds plausible, and most of the folks who tell me the tale swear they heard it from some reliable source. But truth be told, there has not been one officially documented case by the petroleum industry of a cell-phone induced fire at a gas station. Both the American Petroleum Institute (API) and the Petroleum Equipment Institute (PEI) have been tracking this issue for several years and confirm: There are no cases of this incident that have been verified. A spokesman for API told me rather bluntly, "You would think that with 11 billion refueling stops each year and probably at least that many cell phones, we would know about this by now."

Sorry to burst your bubble but it seems like the exploding cell phone is like a number of excellent but misleading urban legends. Like the Poodle in the Microwave, the Kentucky Fried Rat, the Vanishing Hitchhiker, the Exploding Cell Phone is just one of those things made popular and accessible by the Internet. In fact, when I typed in "cell phone gas station" into a search engine on the Internet, guess what was the first hit? *www.urbanlegends.com* For the full story, see *http://urbanlegends.about.com/library/weekly /aa062399.htm.*

For those who say "yeah, but it could happen," I leave you with this fact: Last year, the U.S. Minerals Management Service investigated an alleged exploding cell phone by running a series of complex tests in a laboratory, trying to recreate the conditions that caused the accident. The result? They could not get the phone to blow. No matter how hard they tried and tried, no boom. For those who want to see the report, go to *http://www.mms.gov/safetyalerts/6.htm.*

So what's up with the signs at the pumps that say DON'T USE CELL PHONE? My personal theory is that the industry wants people paying attention during fuel up and not yakking to the spouse about what's for dinner. Which is actually pretty good advice. ■

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